

ATMOSPHERIC POLLEN INCIDENCE AT KODAIKANAL (INDIA)

R. SATHEESH, *G.R. RAO AND P.K.K. NAIR

Environmental Resources Research Centre, P.B. No: 1230, Peroorkada P.O. Thiruvananthapuram - 695 005, Kerala, India.

**Department of Botany, Bharathidasan University, Tiruchirapalli, 620 024, Tamil Nadu, India.*

(Accepted Aril 1993)

The airborne pollen grains have been indentified and monitored continuously for the period 1987-1988 with an aeroscope, at Kodaikanal. Pollen grains of 45 types were identified and seasonal incidence of seventeen dominant taxa is presented in the form of a calendar for two years. Pollen analysis and its seasonal variations are discussed.

Key Words : Pollen, airborne, Kodaikanal.

Pollen grains are one of the chief components of the airspora. Although the information on pollen incidence in the airspora of various places in India and abroad are substantial (Nilsson *et al.*, 1977; Lewis *et al.*, 1983; Nair *et al.*, 1986), very little information is available on the hill stations of the Western Ghats of the Indian Peninsula which is attracting large number of tourists from all over the country. In view of this, an attempt has been made to prepare a pollen calendar showing the incidence of pollen grains in the air at Kodaikanal, the famous hill station of the Western Ghats in Tamil Nadu.

MATERIALS AND METHODS

Kodaikanal, (10°12' and 10°15' N and 77° 26' and 77° 33' E) is situated at an elevation of 2133m near the eastward off shore of the Western Ghats in Tamil Nadu. The climate is a wet tropical montane (Legris & Blasco, 1969), characterised by a winter season (January to March), summer season (April to June), south west monsoon season (October to December). Temperature is moderate with little variation irrespective of the altitude. Kodaikanal receives widespread rain throughout the year from northeast and southwest monsoons. However, from January to March, rainfall is scarce and this period is considered as drier.

The vegetation of Kodaikanal is rich and characteristic of the tropical Western Ghats with a mixture of both indigenous and exotic plants of angiosperms and gymnosperms. The indigenous flora is mostly now confined to the shola forests and grass lands occurring in sheltered valleys or along folded formations of the undulating plateau. Most of the other areas are now covered with monoculture plantations of exotic species, introduced knowingly or unknowingly for

agricultural, ornamental or commercial purposes.

Air Sampling : Airborne pollen grains were monitored daily using an aeroscope placed on the terrace of the Biology Department of the Kodaikanal International School at a height of about 14 metres from the ground for a period of two years, from January 1st, 1987 to December 31st, 1988. The sampling site is surrounded by abundant vegetation of both indigenous and exotic plants. Mostly the vegetation nearby the site consisted of plants like *Acacia*, *Cupressus*, *Eucalyptus*, *Pinus*, and *Prunus* with several shrubs and herbs grown as weeds apart from the indigenous plants of the Bombay shola forest. There was no big construction above the level of the instrument in the nearby area of the site and therefore the area was fully exposed to have free movement of air. The method used for the preparation of slides for exposure, follows that of Agarwal *et al.* (1973).

Attempts were made to indentify pollen grains up to the lowest taxonomic rank possible. The identification of various morphotypes were confirmed by comparing them with pollen reference slides prepared from the plants in the vegetation and published literature. The data were processed, as monthly total and expressed in terms of pollen incidence for one month.

RESULTS

Pollen grains of 45 types belonging to 40 families were identified from the atmosphere of Kodaikanal during the year 1987-1988 (Table 1). Among the 45 pollen types identified 17 of them were found dominant and these types together formed 95% of the total annual pollen count (Table 2).

Table 1: Airborne pollen types of Kodaikanal

<i>Acacia</i> Sp.	<i>Lantana</i> Sp.
<i>Ageratina glandulosum</i> H.B. K.	Lauraceae
<i>Ageratum houstonianum</i> Mill.	<i>Lobelia excelsa</i> Lesch.
<i>Alnus nepalensis</i> D. Don.	<i>Meliosma</i> Sp.
Amaranthaceae	<i>Michelia</i> Sp.
<i>Artemisia nilagirica</i> Pamp.	<i>Nymphaea</i> Sp.
<i>Clematis</i> Sp.	<i>Osbeckia leschaenaultiana</i> DC.
Cruciferae	Papilionaceae
<i>Cryptomeria japonica</i> D. Don.	<i>Phytolacca octandra</i> L.
<i>Cupressus</i> Sp.	<i>Pinus</i> Sp.
Cyperaceae	Poaceae
<i>Dendrophloe</i> Sp.	<i>Prunus</i> Sp.
<i>Eleocarpus</i> Sp.	<i>Pyrus communis</i> L.
Ericaceae	<i>Quercus</i> Sp.
<i>Eriocaulon</i> Sp.	<i>Schafflera racemosam</i> Harns.
<i>Eucalyptus</i> Sp.	<i>Schima wallichii</i> (DC) Choisy.
Euphorbiaceae	Scrophularaceae
Fern spores	Solanaceae
<i>Fuchsia</i> Sp.	<i>Syzygium</i> Sp.
<i>Hypericum mysurense</i> Wt. & Arm.	<i>Taraxacum officinale</i> Web.
<i>Ilex</i> Sp.	Umbelliferae
<i>Jacaranda mimosifolia</i> D. Don.	<i>Zantedeschia aethiopica</i> (L) Spreng.
<i>Juncus</i> Sp.	

Based on the monthly pollen counts, seasonal variations in the contribution of pollen to the atmosphere by the dominant taxa were analysed separately and are presented in the form of a calendar (Fig. 1) and are discussed in the order of their dominance.

Cupressus : The *Cupressus* trees were introduced to Kodaikanal as early as 1906 by the forest department on a plantation scale and have become so common and abundant to become a permanent feature of any tract of vegetation. The incidence of *Cupressus* pollen were noticed throughout the year with the major seasons from November to April. The highest peak was recorded in February in both years. The maximum number of *Cupressus* pollen would have come from *C. funebris.*, *C. torulosa.*, *C. sempervirens* and *C. macrocarpa*. It has been observed that one or the other tree was flowering allthrough the year and may be contributing pollen to the atmosphere either, heavily or sparingly, at various times of the year.

Poaceae : The Poaceae represented by more than 20 common species, were the second largest contributor of pollen in the atmosphere of Kodaikanal. The pollen grains were observed all the year round with peaks in January, 1987 and November, 1988 due to the flowering of various species at different times. The least pollen was recorded during April in both the years. The major contributors of Poaceae pollen grains

Table 2: Airborne pollen types with annual total count and percentage contribution

Pollen type	Total count		Percentage	
	1987	1988	1987	1988
<i>Acacia</i>	377	539	01.17	01.55
<i>Ageratina glandulosum</i>	317	404	00.98	01.16
<i>Ageratum nepalensis</i>	308	402	00.95	01.16
<i>Alnus nepalensis</i>	421	417	01.30	01.20
<i>Artemisia</i>	844	960	02.61	02.76
<i>Cryptomeria japonica</i>	403	489	01.25	01.41
<i>Cupressus</i>	16891	17569	52.18	50.65
<i>Eucalyptus</i>	756	898	02.34	02.59
<i>Ilex</i>	233	150	00.72	00.43
<i>Juncus</i>	303	474	00.94	01.37
<i>Phytolacca octandra</i>	370	487	01.14	01.40
<i>Pinus</i>	3581	2941	11.06	08.48
Poaceae	4503	5438	13.91	15.68
<i>Prunus</i>	314	496	00.97	01.43
<i>Pyrus communis</i>	518	734	01.60	02.12
<i>Quercus</i>	259	179	00.80	00.52
<i>Schima wallichii</i>	185	151	00.57	00.44
Other types	1721	1859	05.31	05.36
Unidentified	65	97	00.20	00.29
Total	32369	34684	100.00	100.00

might be *Bromus uniolooids*, *Cymbopogon martinii*, *Heteropogon contortus* and *Poa annua* which were found abundantly in the vegetation.

Pinus : Among the extensively cultivated plants, *Pinus* held an important place. Ever since the inception of *Pinus* into Kodaikanal vegetation, a number of species were introduced among which *P. radiata* and *P. teada* were the most dominant. The pollen season of *Pinus* started during early December and ended in middle of August, with a peak during February to March.

Artemisia : The incidence pollen was recorded in the atmosphere almost all the year round except July, 1987 and June to July in 1988. The incidence of pollen showed its peak during November to January.

Eucalyptus : *Eucalyptus* pollen grains were observed in the atmosphere from September onwards to June with peak in November. The main pollen contributors may be *E. globulus* and *E. citriodora*. The incidence of *Eucalyptus* pollen exhibited marked seasonal variations as the concentration increased from October, reached peak in November and then declined.

Pyrus communis : Among the fruit trees of Kodaikanal the "Country pear" (*Pyrus communis*) is the most extensively cultivated species. The pollen of *Pyrus* had a distinct season, its aerial incidence-

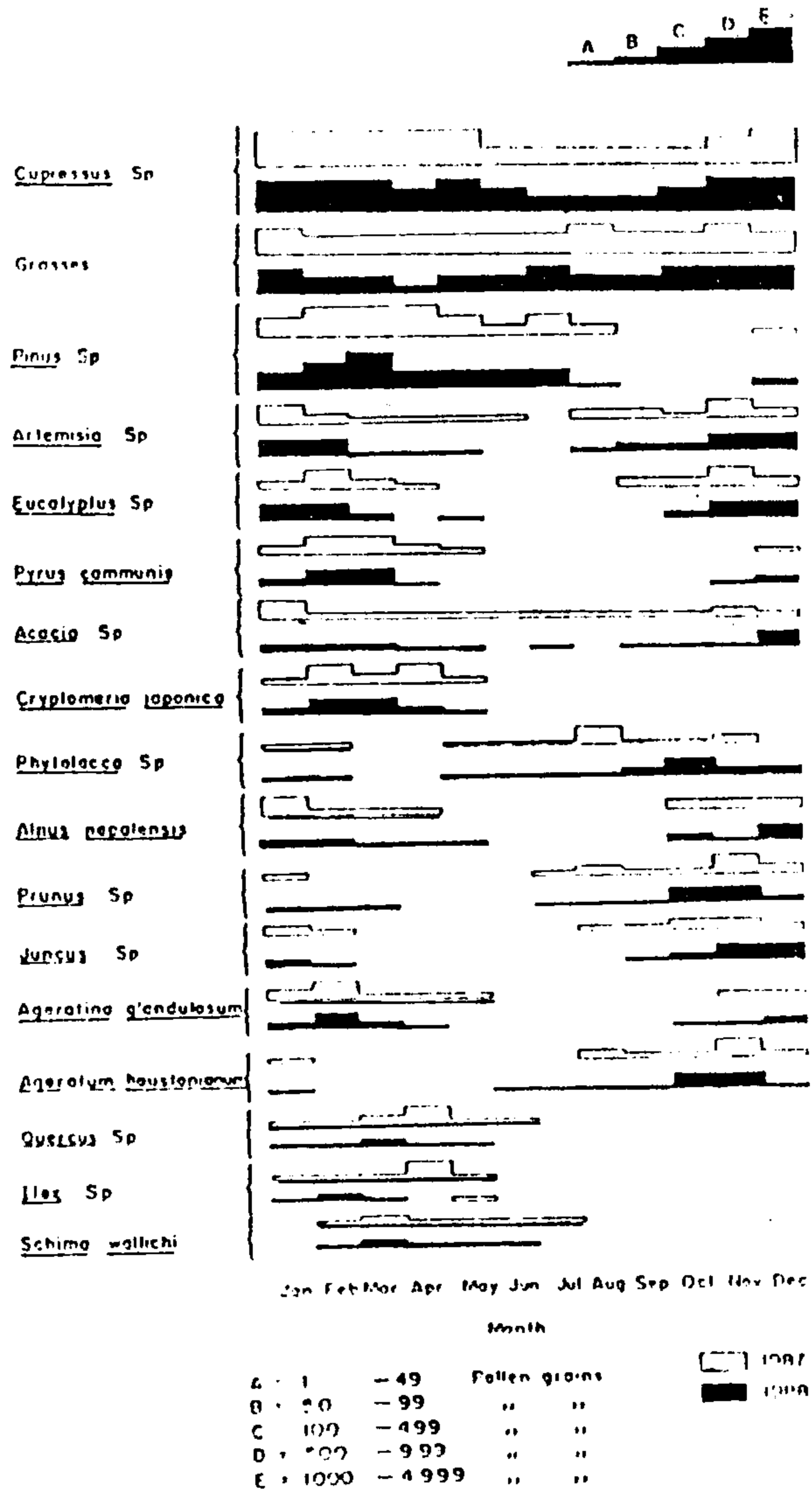


Figure 1. Airborne pollen calendar of Kodaikanal for 1987-88.

being from November to May with peak in February and March.

Cryptomeria japonica : The pollen season of this conifer started during the first week of January and last up to May. The highest peak was recorded in the month of February, 1987 and March, 1988.

Acacia : The pollen season of *Acacia* is relatively long, and it started in early August and ended in June. However, very negligible amount of pollen grains were trapped in some months during the end of the season. The highest peaks were registered in January, 1987 and December, 1988 eventhough, pol-

len incidence were noted allthrough the year. The major pollen contributors could be *A. dealbata*, *A. decurrens* and *A. mearnsii* as they were found abundant in the surrounding area of the sampling site.

Phytolacca octandra : The pollen season of *Phytolacca octandra* started in May and persisted for a long time till February with a peak in August, 1987 and October, 1988. The lowest pollen catch was recorded in February, 1988.

Alnus nepalensis : The pollen season is relatively short and it started in early October and ended in April 1987 and continued till May in 1988, with major pollen incidence from December to January.

Prunus : The pollen season of *Prunus* started in July and continued untill January in 1987 and up to the first week of April, in 1988. The peak season of pollen incidence were noted from November to October. *P. cerasoides* and *P. salicina* could be the major contributors of pollen in the atmosphere.

Juncus : The *Juncus* pollen was observed in the atmosphere from August to February with highest peaks during November and December in 1987 and 1988, respectively. The *J. prismatocarpus* and *J. inflexus* could be the major contributors of pollen in the atmosphere.

Ageratina glandulosum : *Ageratina* is one of the most widely spread and established weed of Kodaikanal. The incidence of pollen had a distinct season starting from October to May with a peak in February for both 1987 and 1988.

Ageratum houstonianum : The "Mexican Blue Foss" (Panjipullu) is another most abundant and common weed of Kodaikanal. The pollen grains of *Ageratum* was noticed in the air from June onwards till February with peak in October and November.

Other pollen types : The *Ilex*, *Quercus*, *Schima* and other plant types that contributed pollen in the atmosphere also showed seasonal variation in pollen contribution, during the year 1987-1988.

DISCUSSION

In India, airborne pollen sampling studies have been attempted for years using various methods and by and large the gravity slide method (Durham, 1946) has been found to be the most useful and universally followed for all preliminary practical purposes because of its simplicity, economy, and in obtaining rea-

sonably good qualitative information. The aeroscope presently used is based on the above principle and was being used at various centers under the AICP project on Aerobiology (Nair *et al.*, 1986), so that comparison with presently available data is made feasible.

In general, pollen aerospora at Kodaikanal reflected the mixed vegetation of both angiosperms and gymnosperms of which the latter dominate. It is now well established that pollen emission and its incidence in the air is largely synchronous with the flowering of plants in the locality and the pollination mechanism in the flower which in turn related to the pollen presentation mechanism of the flower (Faegri and Iversen, 1964; Gregory, 1973; Edmonds, 1979). The *Acacia*, *Cupressus* and *Poaceae* contributed pollen in the air throughout the year, however, the woody plants comprising *Alnus*, *Cryptomeria*, *Eucalyptus*, *Ilex*, *Pinus*, *Prunus*, *Pyrus*, *Quercus* and *Schima* were restricted their pollen contribution to four to five months. The abundant and continuous occurrence of *Acacia*, *Cupressus*, *Poaceae*, and the restricted presence of other pollen types in the air at Kodaikanal could be an indication of the influence of flowering pattern and the abundant occurrence of these plants in the ground vegetation coupled with their pollination mechanism.

Among the herbaceous taxa, the pollen grains of *Ageratina*, *Ageratum*, *Artemisia*, *Juncus* and *Phytolacca* were found to be mainly restricted to the months from August to May with a peak of each coinciding with the peak flowering season of the respective taxa. From the pollen calendar it may be noted that during the period of study there was no pollen free month in Kodaikanal. Similar pollen calendars have been prepared for various centres in India and other countries (Nair *et al.*, 1986; El-Ghazaly and Fawzy, 1988), and when compared it is found that pollen types, its incidence and concentration are varying in different centres. The preliminary pollen calendar prepared on the basis of the two year continuous monitoring of pollen grain in the air at Kodaikanal may be a useful guide to the tourists prone to pollen allergy and be a ready reckoner to the medical practitioners in the diagnosis and treatment of pollen respiratory allergy patients.

The Senior author wishes to thank the C.S.R.I. New Delhi, for financial assistance.

REFERENCES

- Agarwal M K, K Singh, S Chanda, P K K Nair & V S Balawa 1973 *Methods of Research on Allergy and Related Disciplines, Tech Bull. 2 Aerobiology and Allergens*, Pollen, Mold and Insect Committee, Indian College of Allergy and Applied Immunology, Archana Publishers New Delhi (India) 22 pp.
- Durham O C 1946 The volumetric incidence of atmospheric allergens - IV, A proposed standard method of gravity sampling, counting and volumetric interpolation of results *J Allergy* 17 70.
- Edmonds R L 1979 *Aerobiology - the Ecological System Approach* Dowden Hutchinson & Ross Inc Pennsylvania 386 pp.
- El- Ghazaly G & M Fawzy 1988 Pollen calendar of Alexandria Egypt 1981-1982, *Grana* 21 85-87.
- Faegri K & J Iversen 1989 *Text Book of Pollen Analysis* 4th ed. John Wiley & Sons, New York 328 pp.
- Gregory P H 1973 *The Microbiology of the Atmosphere* 2nd ed. Plant Sci Monographs Leonard Hill Books London 126 pp.
- Legris P & F Blasco 1969 *Variabilite des facteurs du climat Tri Sect Sci Tech T. 8 : 94 p.*
- Lewis W H, P Vinay & V E Zenger 1983 *Airborne and allergenic Pollen of North America* John Hopkins University Press Baltimore USA 254 pp.
- Nair P K K, A P Joshi & S V Gangal 1986 *Airborne Pollen, Spores and other Plant Materials of India A survey* C.S. I R. Centre for Biochemicals Delhi and National Botanical Research Institute Lucknow India 224 pp.
- Nilsson S, J Praglowski & N Nilsson 1977 *Atlas of Airborne Pollen grains and Spores in Northern Europe*, Alimquist Wiksell International Stockholm Sweden.